

CLAIMS

1. A method for signaling and waiting to suspend a first device, said first device being connected to a second device via a communications medium, said method comprising:

sending an idle request from the first device to the second device when the first device is ready to suspend; and

waiting, by the first device, to receive a call from the second device to a callback function associated with the first device to suspend the first device.

2. The method of claim 1, wherein the second device is a computer and the first device is a peripheral component associated with the computer.

3. The method of claim 2, wherein the peripheral component is selected from a group consisting of a composite device, a root hub, and a controller.

4. The method of claim 1, wherein sending and waiting occur via a driver controlling the first device.

5. The method of claim 1, wherein the first device has an active state and an idle state and wherein the first device is ready to suspend when in the idle state.

6. The method of claim 1, wherein the first device comprises one of a plurality of nodes organized in a tree structure, and wherein the first device comprises a child node of the second device.

7. One or more computer readable media having computer-executable instructions for performing the method recited in claim 6.

8. The method of claim 6, wherein the nodes in the tree are connected via a Universal Serial Bus.

9. The method of claim 6, wherein the first device has one or more child nodes in the tree structure and wherein the first device is ready to suspend when each of the one or more child nodes of the first device is ready to suspend.

10. The method of claim 9, further comprising receiving, by the first device, an idle request from at least one of the child nodes of the first device.

11. The method of claim 10, further comprising propagating the idle request from the first device to a controller at a root of the tree structure.

12. The method of claim 11, wherein propagating the idle request comprises propagating the idle request by inductively traversing the tree structure from the first device to the controller.

13. The method of claim 11, wherein propagating the idle request comprises transmitting the received idle request from the first device to the second device if the first device is ready to suspend and if the first device has received an idle request from each of the child nodes of the first device.

14. The method of claim 11, wherein propagating the idle request comprises:
determining whether the first device has received an idle request from each of the child nodes of the first device;
waiting to receive an idle request from each of the child nodes if an idle request from each of the child nodes has not been received; and
submitting an idle request to the second device if the first device has received an idle request from each of the child nodes.

15. The method of claim 1, wherein sending an idle request comprises transmitting an input/output control (IOCTL) request from the first device to the second device.

16. The method of claim 15, wherein transmitting the IOCTL request comprises transmitting an input/output request packet from the first device to the second device.

17. The method of claim 1, further comprising receiving, by the first device, the call from the second device to the callback function associated with the first device and suspending the first device in response to execution of the received callback function.

18. The method of 17, further comprising waking the first device.

19. The method of 18, wherein waking occurs in response the first device signaling the second device that the first device is ready to wake.

20. The method of claim 18, wherein waking occurs in response to the second device signaling the first device to wake.

21. The method of claim 18, wherein the first device comprises one of a plurality of nodes organized in a tree structure, wherein the first device has one or more child nodes, and wherein waking occurs in response to at least one of the child nodes signaling the first device to wake.

22. The method of claim 18, wherein waking comprises resetting the sent idle requests.

23. The method of claim 1, further comprising sending a cancel request from the first device to the second device when the first device is no longer ready to suspend, said sending a cancel request occurring after sending the idle request.

24. The method of claim 1, further comprising a third device sending an idle request to the second device when the third device is ready to suspend and suspending simultaneously with the first device, said third device having input/output control and function independent from the first device.

25. A method for suspending a tree of devices, said tree comprising one or more devices hierarchically organized as parent devices and child devices in the tree, said tree further comprising a controller at a root of the tree, said method comprising:

receiving, by the controller, an idle request from one or more of the child devices;
and

suspending, by the controller, all devices in the tree after receiving an idle request from each of the devices in the tree.

26. The method of claim 25, wherein receiving an idle request comprises receiving, by the controller, an idle request from one or more of the child devices via software for controlling the child devices.

27. The method of claim 25, wherein suspending comprises executing a callback function for each of the child devices to put the child devices into a low power mode.

28. The method of claim 25, wherein the parent devices and the child devices are connected via a Universal Serial Bus (USB), wherein the tree comprises a USB hub, and further comprising suspending, by the controller, the USB hub.

29. The method of claim 25, wherein the parent devices and the child devices are connected via a Universal Serial Bus (USB), wherein the controller is a computer, wherein the tree comprises a USB controller, and further comprising suspending, by the computer, a USB host controller.

30. The method of claim 25, wherein receiving an idle request comprises receiving, by the controller, an input/output control (IOCTL) request from one or more of the child devices.

31. The method of claim 30, wherein receiving the IOCTL request comprises receiving, by the controller, an input/output request packet from the one or more child devices.

32. The method of claim 25, wherein the parent devices and child devices are connected via a Universal Serial Bus.

33. One or more computer readable media having computer-executable instructions for performing the method recited in claim 25.

34. One or more computer-readable media having computer-executable components for signaling and waiting to suspend a device in a tree of devices, said tree comprising one or more devices hierarchically organized as parent devices and child devices, said tree having a controller at a root of the tree, said components comprising:

a signaling component for sending an idle request from at least one child device to a parent device when the child device is ready to suspend, wherein the idle request propagates through the tree from the parent device to the controller; and

a driver component for waiting to receive, by the child device, a call from the controller to a callback function associated with the child device to suspend the child device.

35. The method of claim 34, wherein the signaling component receives an idle request from at least one child of the child device, and wherein the signaling component sends the received idle request to the parent device.

36. The computer-readable media of claim 34, wherein the signaling component receives a call to a callback function from the controller in response to the propagated idle request.

37. The computer-readable media of claim 36, wherein the driver component suspends the child device in response to execution of the callback function.

38. The computer-readable media of claim 37, wherein the driver component wakes the child device in response to activity by the child device or a signal from the parent device or both.

39. The computer-readable media of claim 34, wherein the callback function comprises a power down function for powering down the child device.

40. The computer-readable media of claim 39, wherein the power down function comprises a low power function for putting the child device into a low power mode.

41. The computer-readable media of claim 34, wherein the parent devices and child devices are connected via a Universal Serial Bus.

42. The computer-readable media of claim 34, wherein the signaling component sends a cancel request from the child device to the parent device in response to non-idle activity by the child device.

43. One or more computer-readable media having computer-executable components for asserting power control over a tree of devices by a controller at a root of the tree, said tree comprising one or more devices hierarchically organized as parent devices and child devices in the tree, said components comprising:

an interface component for receiving, by the controller, an idle request from one or more child devices; and

a controller component for suspending, by the controller, all devices in the tree after receiving an idle request from each of the child devices.

44. The computer-readable media of claim 43, wherein the controller wakes the devices in the tree in response to activity by the controller or any of the devices or both.

45. The computer-readable media of claim 43, wherein the child device comprises a Human Interface Device (HID).

46. The computer-readable media of claim 43, wherein the child device comprises a device embedded in a computer.

47. The method of claim 43, wherein the parent devices and child devices are connected via a Universal Serial Bus.

48. A computer-readable medium having stored thereon a data structure representing an idle request, said data structure comprising:

- a first field storing a routine attribute representing a callback function; and
- a second field storing a context attribute representing a callback context, wherein a first device transmits an idle request to a second device via said data structure when the first device is ready to suspend, said callback function executing to suspend the first device in response to the first device transmitting the idle request, and said callback context providing an environment for executing said callback function.

49. The method of claim 48, wherein the first device has one or more child nodes organized in a tree structure, wherein the first device has an active state and an idle state, and wherein the first device is ready to suspend when each of the one or more child nodes of the first device is ready to suspend.

50. The method of claim 48, wherein the first device and the second device are connected via a Universal Serial Bus.